Derivation of the answers to Example 2 on page 1 of the file FinalExamExercises.pdf (on Brightspace):

Call/Pass by Value

Call/Pass by Value-Result

Call/Pass by Value-Result (Algol W)

Call/Pass by Reference

Call/Pass by Name

Call/Pass by Value

Comment: Suppose a function **f** with a
formal parameter **p** is called this way: **f(v);**

If **f**'s argument is passed **by value**, then
when **f** executes an assignment **p = … ;**
the assignment stores something in **p**'s location
but ***does not modify the contents of*** **v**'s ***location***.

Comment: Suppose a function f with a
formal parameter p is called this way: **f(v);**

If f's argument is passed **by value**, then
when f executes an assignment **p = … ;**
the assignment stores something in p's location
but ***does** **not** **modify the contents of*** v's ***location***.

In Java and Lisp, all arguments are passed by value.

Note:

Comment: Suppose a function f with a formal parameter p is called this way: f(v);

If f's argument is passed **by value**, then when f executes an assignment p = … ; the assignment stores something in p's location but ***does not modify the contents of*** v's ***location***.

In Java and Lisp, all arguments are passed by value.

Note: If the argument variable v stores an object reference, then that object reference will be copied into f's formal parameter p when the argument is passed by value, and pass by value doesn't prevent f from using p to modify the object v refers to!

Warning:

Comment: Suppose a function **f** with a formal parameter **p** is called this way: **f(v);**

If **f**'s argument is passed **by value**, then when **f** executes an assignment **p = … ;** the assignment stores something in **p**'s location but ***does not modify the contents of*** **v**'s ***location***.

In Java and Lisp, all arguments are passed by value.

Note: If the argument variable **v** stores an object reference, then that object reference will be copied into **f**'s formal parameter **p** when the argument is passed by value, and pass by value doesn't prevent **f** from using **p** to modify the object **v** refers to!

Warning: Don't confuse ***pass by reference*** (as described in the course reader) with ***passing an object reference by value*** (as described in the **Note**). The **Comment** applies to the latter but does ***not*** apply to pass by reference.

PASS BY VALUE

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)
  {
    a[1] = 6;
    e = 2;
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
```

```
               e   1
in heap: a[0]   0
in heap: a[1]   1
in heap: a[2]   2
```

Note: Assuming Java semantics, the memory locations of `a[0]`, `a[1]`, and `a[2]` would be in the heap.

Output:

PASS BY VALUE

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)           e  1
  {                             in heap: a[0]  0
    a[1] = 6;                   in heap: a[1]  1
    e = 2;                      in heap: a[2]  2
    x += 3;
    y--;                                test:
    System.out.print(x + " " + y + " ");   x  1
  }                                        y  0
}
      Output:
```

PASS BY VALUE

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)           e  1
  {                             in heap: a[0]  0
    a[1] = 6;                   in heap: a[1]  1  6
    e = 2;                      in heap: a[2]  2
    x += 3;
    y--;                                test:
    System.out.print(x + " " + y + " ");    x  1
  }                                         y  0
}
      Output:
```

PASS BY VALUE

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)           e  1  2
  {                             in heap: a[0]  0
    a[1] = 6;                   in heap: a[1]  1  6
    e = 2;                      in heap: a[2]  2
    x += 3;
    y--;                                test:
    System.out.print(x + " " + y + " ");    x  1
  }                                         y  0
}
      Output:
```

PASS BY VALUE

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)
  {
    a[1] = 6;
    e = 2;
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
```

```
             e    1  2
in heap: a[0]     0
in heap: a[1]     1  6
in heap: a[2]     2

         test:
             x    1  4
             y    0
```

Output:

PASS BY VALUE

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)           e  1  2
  {                             in heap: a[0]  0
    a[1] = 6;                   in heap: a[1]  1  6
    e = 2;                      in heap: a[2]  2
    x += 3;
    y--;                                test:
    System.out.print(x + " " + y + " ");    x  1  4
  }                                         y  0 -1
}
      Output:
```

PASS BY VALUE

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)           e  1  2
  {                               in heap: a[0]  0
    a[1] = 6;                     in heap: a[1]  1  6
    e = 2;                        in heap: a[2]  2
    x += 3;
    y--;                                  test:
    System.out.print(x + " " + y + " ");    x  1  4
  }                                         y  0 -1
}
      Output:  x  y  a[0]  a[1]  a[2]  e
               4 -1
```

PASS BY VALUE

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)           e  1  2
  {                             in heap: a[0]  0
    a[1] = 6;                   in heap: a[1]  1  6
    e = 2;                      in heap: a[2]  2
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
      Output:  x  y  a[0]  a[1]  a[2]  e
               4 -1
```

PASS BY VALUE

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)           e  1  2
  {                             in heap: a[0]  0
    a[1] = 6;                   in heap: a[1]  1  6
    e = 2;                      in heap: a[2]  2
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
      Output:  x  y  a[0]  a[1]  a[2]  e
               4 -1   0     6     2    2
```

Call/Pass by Value-Result

Call/Pass by Value-Result

An Ada version of the program in this section, which uses pass-by-value-result, is available to you on mars.

Call/Pass by Value-Result

An Ada version of the program in this section, which uses pass-by-value-result, is available to you on mars.

The program is in a file named

pass-by-value-result.ada

and can be viewed by logging in to your xxxxx_yyyy316 mars account and then entering the following command at the xxxxx_yyyy316@mars:~$ prompt:

```
less pass-by-value-result.ada
```

Call/Pass by Value-Result

An Ada version of the program in this section, which uses pass-by-value-result, is available to you on mars.

The program is in a file named

```
pass-by-value-result.ada
```

and can be viewed by logging in to your xxxxx_yyyy316 mars account and then entering the following command at the xxxxx_yyyy316@mars:~$ prompt:

```
less pass-by-value-result.ada
```

To execute the program on mars, enter the following at the xxxxx_yyyy316@mars:~$ prompt:

```
ada pass-by-value-result.ada
```

PASS BY VALUE-RESULT

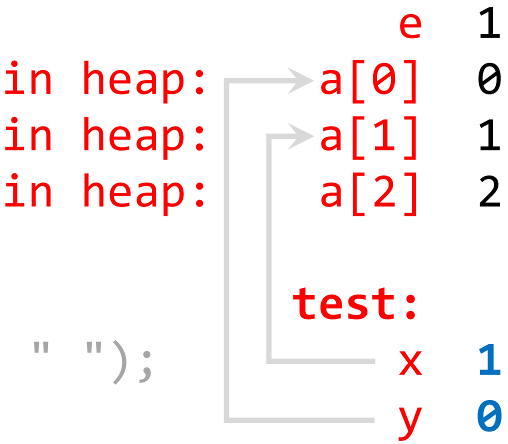
```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)
  {
    a[1] = 6;
    e = 2;
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
```

e	1
in heap: a[0]	0
in heap: a[1]	1
in heap: a[2]	2

Output:

PASS BY VALUE-RESULT

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)
  {
    a[1] = 6;
    e = 2;
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
```

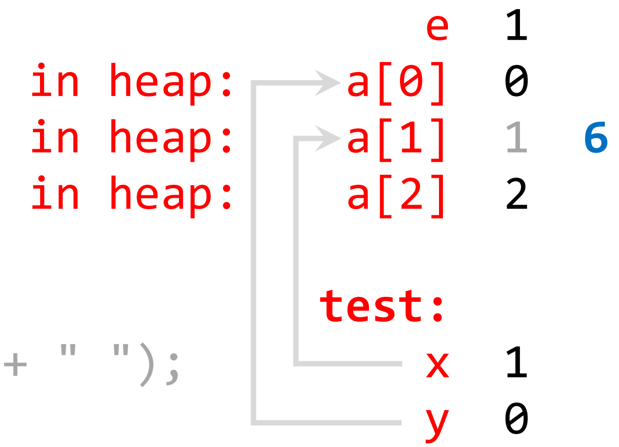

e 1
in heap: a[0] 0
in heap: a[1] 1
in heap: a[2] 2

test:
x 1
y 0

Output:

PASS BY VALUE-RESULT

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)
  {
    a[1] = 6;
    e = 2;
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
```



e 1

in heap: a[0] 0

in heap: a[1] 1 6

in heap: a[2] 2

test:

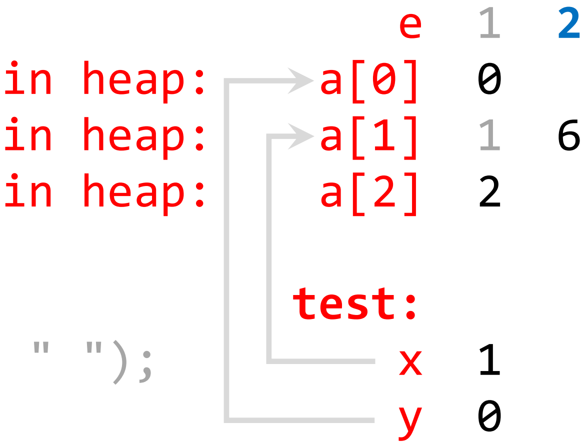
x 1

y 0

Output:

PASS BY VALUE-RESULT

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)
  {
    a[1] = 6;
    e = 2;
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
```



e 1 2

in heap: a[0] 0

in heap: a[1] 1 6

in heap: a[2] 2

test:

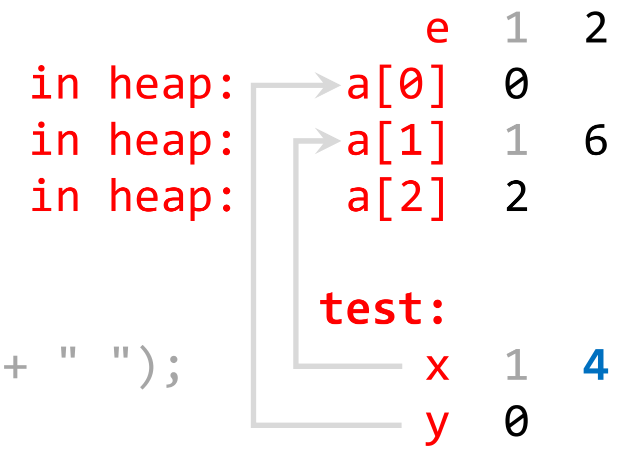
x 1

y 0

Output:

PASS BY VALUE-RESULT

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)
  {
    a[1] = 6;
    e = 2;
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
```



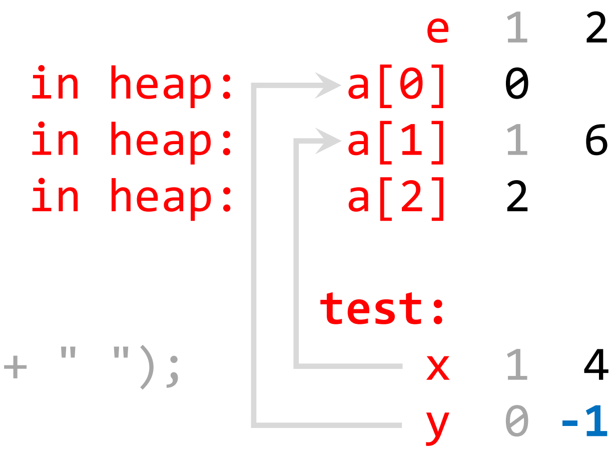
```
                e     1   2
in heap:     a[0]     0
in heap:     a[1]     1   6
in heap:     a[2]     2

          test:
                x     1   4
                y     0
```

Output:

PASS BY VALUE-RESULT

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)
  {
    a[1] = 6;
    e = 2;
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
```

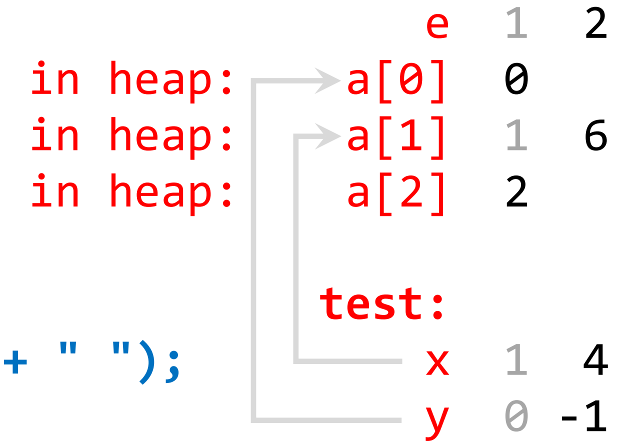
Output:



```
         e     1   2
in heap: a[0]  0
in heap: a[1]  1   6
in heap: a[2]  2

test:
         x     1   4
         y     0  -1
```

PASS BY VALUE-RESULT

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)
  {
    a[1] = 6;
    e = 2;
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
```

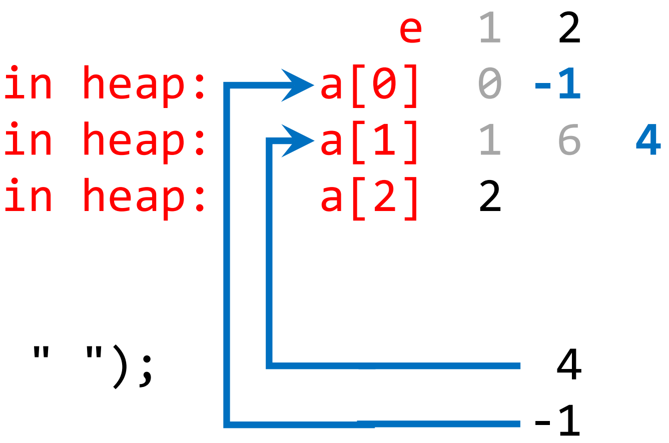


```
                 e     1   2
in heap:       a[0]    0
in heap:       a[1]    1   6
in heap:       a[2]    2

             test:
                 x     1   4
                 y     0  -1
```

```
    Output:  x  y  a[0]  a[1]  a[2]  e
             4 -1
```

PASS BY VALUE-RESULT

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)
  {
    a[1] = 6;
    e = 2;
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
```



```
          e     1  2
in heap:  a[0]  0  -1
in heap:  a[1]  1  6  4
in heap:  a[2]  2

                   4
                   -1
```

```
    Output:  x  y  a[0]  a[1]  a[2]  e
             4 -1
```

PASS BY VALUE-RESULT

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)
  {
    a[1] = 6;
    e = 2;
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
```

	e	1	2	
in heap:	a[0]	0	-1	
in heap:	a[1]	1	6	4
in heap:	a[2]	2		

Output:

x	y	a[0]	a[1]	a[2]	e
4	-1	-1	4	2	2

Call/Pass by Value-Result (Algol W)

Call/Pass by Value-Result (Algol W)

An Algol W version of the program in this section, which uses (Algol-W-style) pass-by-value-result, is available to you on mars.

Call/Pass by Value-Result (Algol W)

An Algol W version of the program in this section, which uses (Algol-W-style) pass-by-value-result, is available to you on mars.

The program is in a file named

pass-by-value-result.algolw

and can be viewed by logging in to your xxxxx_yyyy316 mars account and then entering the following command at the xxxxx_yyyy316@mars:~$ prompt:

```
less pass-by-value-result.algolw
```

Call/Pass by Value-Result (Algol W)

An Algol W version of the program in this section, which uses (Algol-W-style) pass-by-value-result, is available to you on mars.

The program is in a file named

```
pass-by-value-result.algolw
```

and can be viewed by logging in to your xxxxx_yyyy316 mars account and then entering the following command at the xxxxx_yyyy316@mars:~$ prompt:

```
less pass-by-value-result.algolw
```

To execute the program on mars, enter the following at the xxxxx_yyyy316@mars:~$ prompt:

```
algolw pass-by-value-result.algolw
```

PASS BY VALUE-RESULT (ALGOL W)

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)
  {
    a[1] = 6;
    e = 2;
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
```

e	1
in heap: a[0]	0
in heap: a[1]	1
in heap: a[2]	2

Output:

PASS BY VALUE-RESULT (ALGOL W)

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)
  {
    a[1] = 6;
    e = 2;
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
```

```
              e   1
in heap: a[0]   0
in heap: a[1]   1
in heap: a[2]   2

          test:
       a[e] x   1
     a[e-1] y   0
```

Output:

PASS BY VALUE-RESULT (ALGOL W)

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)
  {
    a[1] = 6;
    e = 2;
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
```

```
               e  1
in heap: a[0]  0
in heap: a[1]  1  6
in heap: a[2]  2

        test:
      a[e] x  1
    a[e-1] y  0
```

Output:

PASS BY VALUE-RESULT (ALGOL W)

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)                e  1  2
  {                                  in heap: a[0]  0
    a[1] = 6;                        in heap: a[1]  1  6
    e = 2;                           in heap: a[2]  2
    x += 3;
    y--;                                     test:
    System.out.print(x + " " + y + " ");    a[e] x  1
  }                                       a[e-1] y  0
}
      Output:
```

PASS BY VALUE-RESULT (ALGOL W)

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)
  {
    a[1] = 6;
    e = 2;
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
```

```
                e  1  2
 in heap: a[0]  0
 in heap: a[1]  1  6
 in heap: a[2]  2

         test:
       a[e] x  1  4
     a[e-1] y  0
```

Output:

PASS BY VALUE-RESULT (ALGOL W)

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)                e  1  2
  {                                  in heap: a[0]  0
    a[1] = 6;                        in heap: a[1]  1  6
    e = 2;                           in heap: a[2]  2
    x += 3;
    y--;                                     test:
    System.out.print(x + " " + y + " ");    a[e] x  1  4
  }                                       a[e-1] y  0 -1
}
      Output:
```

PASS BY VALUE-RESULT (ALGOL W)

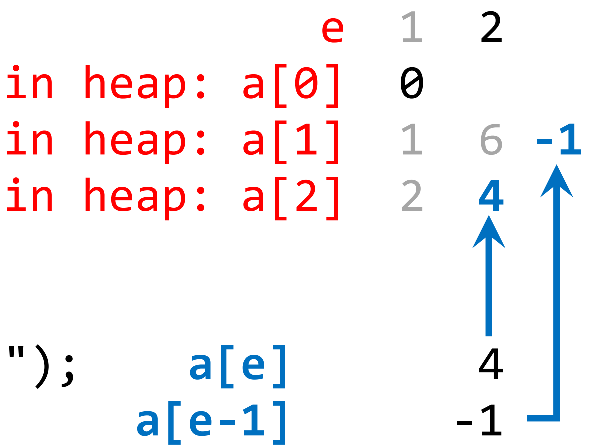
```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)
  {
    a[1] = 6;
    e = 2;
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
```

```
              e  1  2
in heap: a[0]    0
in heap: a[1]    1  6
in heap: a[2]    2

        test:
      a[e] x     1  4
    a[e-1] y     0 -1
```

```
Output:  x  y  a[0]  a[1]  a[2]  e
         4 -1
```

PASS BY VALUE-RESULT (ALGOL W)

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)
  {
    a[1] = 6;
    e = 2;
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
```



```
               e  1  2
in heap: a[0]  0
in heap: a[1]  1  6 -1
in heap: a[2]  2  4
     a[e]         4
   a[e-1]        -1
```

```
      Output:   x  y   a[0]  a[1]  a[2]  e
                4 -1
```

PASS BY VALUE-RESULT (ALGOL W)

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)                      e  1  2
  {                                        in heap: a[0]  0
    a[1] = 6;                              in heap: a[1]  1  6 -1
    e = 2;                                 in heap: a[2]  2  4
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
      Output:  x  y  a[0]  a[1]  a[2]  e
               4 -1    0    -1     4   2
```

Call/Pass by Reference

Call/Pass by Reference

A C++ version of the program in this section, which uses pass-by-reference, is available to you on mars.

Call/Pass by Reference

A C++ version of the program in this section, which uses pass-by-reference, is available to you on mars.

The program is in a file named

pass-by-reference.cpp

and can be viewed by logging in to your xxxxx_yyyy316 mars account and then entering the following command at the xxxxx_yyyy316@mars:~$ prompt:

```
less pass-by-reference.cpp
```

Call/Pass by Reference

A C++ version of the program in this section, which uses pass-by-reference, is available to you on mars.

The program is in a file named

pass-by-reference.cpp

and can be viewed by logging in to your xxxxx_yyyy316 mars account and then entering the following command at the xxxxx_yyyy316@mars:~$ prompt:

```
less pass-by-reference.cpp
```

To execute the program on mars, enter the following at the xxxxx_yyyy316@mars:~$ prompt:

```
g++ pass-by-reference.cpp
./a.out
```

PASS BY REFERENCE

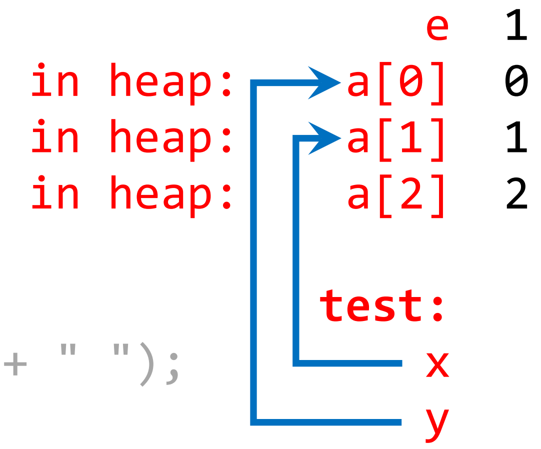
```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)
  {
    a[1] = 6;
    e = 2;
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
```

e	1
in heap: a[0]	0
in heap: a[1]	1
in heap: a[2]	2

Output:

PASS BY REFERENCE

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)
  {
    a[1] = 6;
    e = 2;
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
```



e 1

in heap: a[0] 0

in heap: a[1] 1

in heap: a[2] 2

test:

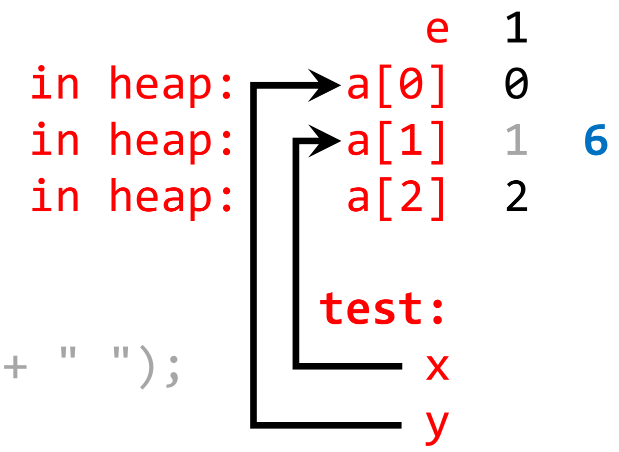
x

y

Output:

PASS BY REFERENCE

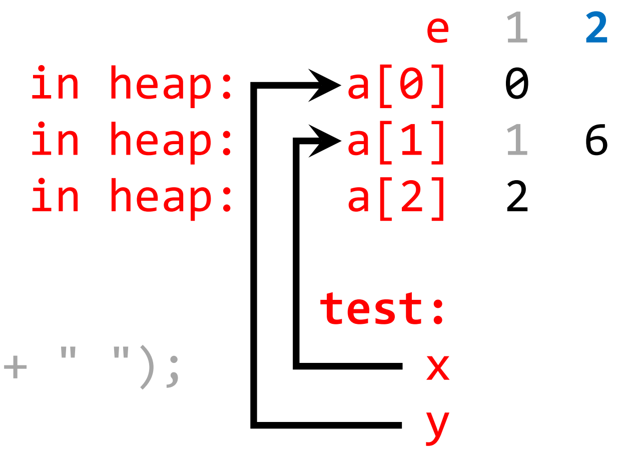
```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)
  {
    a[1] = 6;
    e = 2;
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
```



Output:

PASS BY REFERENCE

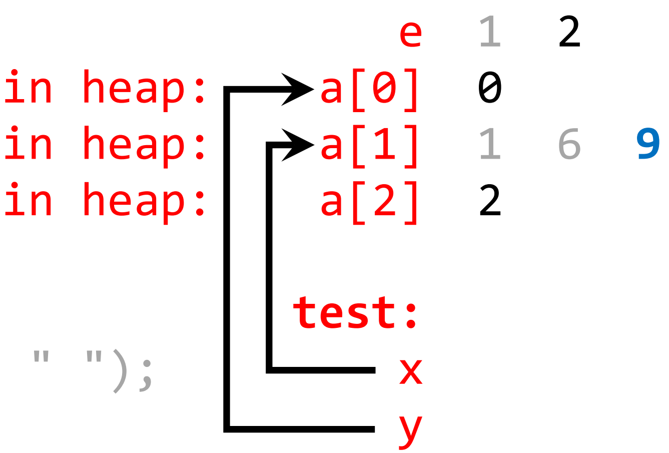
```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)
  {
    a[1] = 6;
    e = 2;
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
```



Output:

PASS BY REFERENCE

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)
  {
    a[1] = 6;
    e = 2;
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
```



e 1 2

in heap: a[0] 0

in heap: a[1] 1 6 9

in heap: a[2] 2

test:

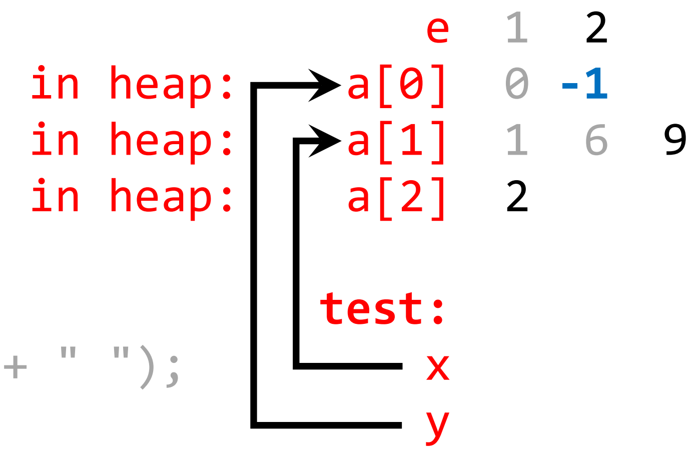
x

y

Output:

PASS BY REFERENCE

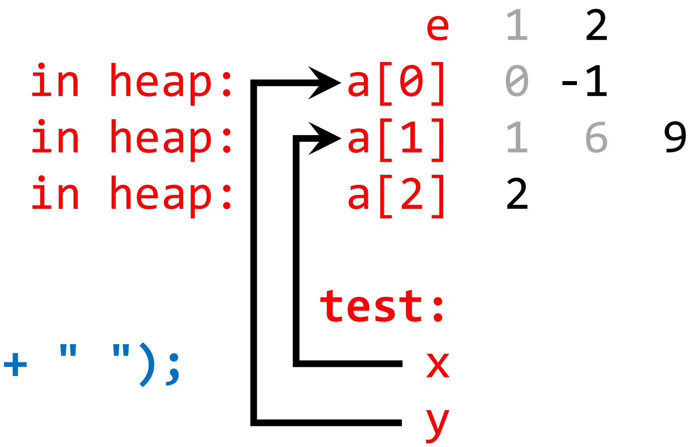
```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)
  {
    a[1] = 6;
    e = 2;
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
```



Output:

PASS BY REFERENCE

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)
  {
    a[1] = 6;
    e = 2;
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
```



```
                    e     1   2
in heap:  a[0]  0  -1
in heap:  a[1]  1   6   9
in heap:  a[2]  2

test:
          x
          y
```

```
    Output:   x   y   a[0]   a[1]   a[2]   e
              9  -1
```

PASS BY REFERENCE

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)
  {
    a[1] = 6;
    e = 2;
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
```

	e	1	2	
in heap:	a[0]	0	-1	
in heap:	a[1]	1	6	9
in heap:	a[2]	2		

```
Output:  x  y  a[0]  a[1]  a[2]  e
         9 -1
```

PASS BY REFERENCE

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)
  {
    a[1] = 6;
    e = 2;
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
```

```
                  e     1  2
in heap:    a[0]  0 -1
in heap:    a[1]  1  6  9
in heap:    a[2]  2
```

```
Output:  x   y   a[0]   a[1]   a[2]   e
         9  -1    -1      9      2    2
```

Call/Pass by Name

Call/Pass by Name

An Algol W version of the program in this section, which uses pass-by-name, is available to you on mars.

Call/Pass by Name

An Algol W version of the program in this section, which uses pass-by-name, is available to you on mars.

The program is in a file named

```
          pass-by-name.algolw
```

and can be viewed by logging in to your xxxxx_yyyy316 mars account and then entering the following command at the xxxxx_yyyy316@mars:~$ prompt:

```
          less pass-by-name.algolw
```

Call/Pass by Name

An Algol W version of the program in this section, which uses pass-by-name, is available to you on mars.

The program is in a file named

```
pass-by-name.algolw
```

and can be viewed by logging in to your xxxxx_yyyy316 mars account and then entering the following command at the xxxxx_yyyy316@mars:~$ prompt:

```
less pass-by-name.algolw
```

To execute the program on mars, enter the following at the xxxxx_yyyy316@mars:~$ prompt:

```
algolw pass-by-name.algolw
```

PASS BY NAME

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)
  {
    a[1] = 6;
    e = 2;
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
```

e	1
in heap: a[0]	0
in heap: a[1]	1
in heap: a[2]	2

Output:

PASS BY NAME

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)
  {
    a[1] = 6;
    e = 2;
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
```

e	1
in heap: a[0]	0
in heap: a[1]	1
in heap: a[2]	2

test:

a[e]	x
a[e-1]	y

Output:

PASS BY NAME

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)
  {
    a[1] = 6;
    e = 2;
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
```

```
              e  1
in heap: a[0]  0
in heap: a[1]  1  6
in heap: a[2]  2

        test:
         a[e] x
       a[e-1] y
```

Output:

PASS BY NAME

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)
  {
    a[1] = 6;
    e = 2;
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
```

e	1	2
in heap: a[0]	0	
in heap: a[1]	1	6
in heap: a[2]	2	

test:

a[e]	x
a[e-1]	y

Output:

PASS BY NAME

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)
  {
    a[1] = 6;
    e = 2;
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
```

e	1	2
in heap: a[0]	0	
in heap: a[1]	1	6
in heap: a[2]	2	5

test:

a[e]	x
a[e-1]	y

Output:

PASS BY NAME

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)
  {
    a[1] = 6;
    e = 2;
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
```

e	1	2	
in heap: a[0]	0		
in heap: a[1]	1	6	5
in heap: a[2]	2	5	

test:

a[e]	x
a[e-1]	y

Output:

PASS BY NAME

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)
  {
    a[1] = 6;
    e = 2;
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
```

```
              e     1  2
in heap: a[0]  0
in heap: a[1]  1  6  5
in heap: a[2]  2  5

         test:
         a[e] x
       a[e-1] y
```

```
Output:  x  y  a[0]  a[1]  a[2]  e
         5  5
```

PASS BY NAME

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)                  e  1  2
  {                                    in heap: a[0]  0
    a[1] = 6;                          in heap: a[1]  1  6  5
    e = 2;                             in heap: a[2]  2  5
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
```

```
    Output:  x  y  a[0]  a[1]  a[2]  e
             5  5
```

PASS BY NAME

```
class FinalExam {
  static int e = 1;
  static int a[] = {0,1,2};

  public static void main(String args[])
  {
    test(a[e], a[e-1]);
    System.out.println(a[0] + " " + a[1] + " " + a[2] + " " + e);
  }

  static void test (int x, int y)                e  1  2
  {                                  in heap: a[0]  0
    a[1] = 6;                        in heap: a[1]  1  6  5
    e = 2;                           in heap: a[2]  2  5
    x += 3;
    y--;
    System.out.print(x + " " + y + " ");
  }
}
      Output:  x  y  a[0]  a[1]  a[2]  e
               5  5    0     5     5   2
```